Power Management Controls

Project Scope and Research Topics

This discussion identifies particular issues that the power management controls project will address. This list was prepared for the Professional Advisory Committee (PAC) meeting on November 2, 2000, with initial (shorter) topic descriptions. At the meeting, the PAC ranked each topic for importance and level of effort to be expended. The list was reordered based on this ranking and the descriptions expanded and modified based on the discussion. This entire project scope and topic listing was approved by the PAC at the meeting. The PAC will revisit this list in future meetings and have the opportunity to suggest changing the rankings and descriptions. Including the topic in the research plan does not mean that we intend to make recommendations about it; the evaluation of battery controls and indicators is an example of this.

Project Scope

User Interface (UI) Elements

The types of user interface elements that are the subject of this project are individual **Terms**, **Symbols**, **Indicators**, and **Switches & Buttons**. Beyond the individual elements, we will also address how they operate and work together. One aspect of this is **Device Behavior**, which includes descriptions of different power management options within a device, or combinations of indicators, or transition sequences. Device behavior also includes more complex ideas, such as weekly timers, and whether multiple delay timers occur in series or in parallel. A final element is the overall concept—the "**Operating Metaphor**"—that people bring to their understanding of power management. An example of this is the idea that devices are 'asleep' which provides for terms such as being in a 'sleep' mode or 'waking up', symbols such as a moon, etc.

Locations of UI Elements

User Interface Elements may appear fixed on the **outside** of devices, on **displays** (status indicators or control panels), on **remote devices**, or in manuals and other **documentation**. They may help indicate the device's state, the effect of a switch, or the effect of an automatic control. Documentation can occur in traditional manuals, within software, or be available on the Internet.

Types of Devices

Our primary focus is **office equipment** (PCs, monitors, printers, copiers, fax machines, etc.), but some attention will be paid to other types of electronic devices that consumers commonly interact with (e.g. Portable Digital Assistants, and **consumer electronics**). It is likely that in future, power management will be used on many types of devices that presently don't visibly power manage, or device categories that today don't exist in any quantity. The amount of effort to be devoted to consumer electronics will be periodically reviewed by the PAC and possibly adjusted. The opportunity to define standards for non-office equipment devices should not be missed so long as it does not impair the project success for the core set of devices—office equipment.

The Project Scope does <u>not</u> include

Issues related safety. Power levels or delay times. Labeling or certification. Security. Internal protocols/mechanisms for power management, including terminology not intended for final users. Discussion or recommendation of ideas subject to intellectual property claims.

Data Collection and Approach

Core data collection efforts will be generally limited to devices currently available (for sale or lease) in the United States. This sets aside devices no longer available—even though they may be still present in homes and offices—as well as devices only obtainable in other countries. Exceptions to this limitation will be made for devices that provide particular insights, but the general guidance will help keep the effort tractable. Initially, all device data will be collected by Berkeley Lab directly, but once the types of data needed are clear, manufacturers (particularly PAC members) will provide some of the data.

We will explore each of these topics in some detail, collecting initial data, to provide the PAC with sufficient information to better target and prioritize the topics. This will include lists of specific examples, such as devices included or excluded from the analysis (with some discussion as to why), and examples that well illustrate a particular topic.

Topic Areas

The topic areas below are listed with their rankings by the PAC for Priority (1 the highest) and Effort warranted (Large, Medium, or Small). The topics below cover a broad range, including particular device configurations or situations, how power management interacts with other modes and external events, characteristics of particular user groups, mode transitions, and operating metaphors.

Subsequent to the November 2 meeting, it became apparent to Berkeley Lab that direct examination of some of the user interface elements did not fit cleanly into any of the listed topic areas, so we added two more on ‘basic symbols and switches & buttons’ and ‘basic indicators’. Both of these are core to the project, part of the scope the PAC approved, but best organized under their own topic areas. Basic terms is part of the ‘underlying archetype’ topic. Table 1 lists the topic names by priority, along with their anticipated level of effort.

Table 1. Research Topic Names

Priority 1 Topics	**Priority 2 Topics**
Basic symbols and switches & buttons	Disability [M]
Basic indicators	Culture [S]
Changing power states [L]	Temporary changes [S]
Transition indicators [L]	System status after power failure [S]
Underlying archetype of power management behavior, including basic terms [L]	Terminology [S]
Controlled and controlling devices [L]	Miscellaneous [S]
Remote indicators and controls [L]	
Composite devices and diversity of low-power modes [L]	**Priority 3 Topics**
Power management ‘schemes’ [L]	Language [S]
Behavior based on wake event type [M]	Batteries [S]
Linked behavior [L]	Role of the term “ENERGY STAR” [S]
Interactions with non-power modes [S]	Self-monitoring [S]

A topic on the applicability of the controls standardization to imaging was dropped by the PAC. This would have gleaned insight on how some user interface convergence might be achievable for imaging controls to improve user experience and facilitate greater use of paper-saving features.

Priority 1 Topics

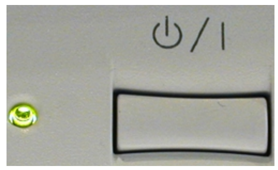
Basic symbols and switches & buttons

Switches and buttons for changing power states are usually associated with one or more symbols to indicate what they do, and (for toggle switches) the current state. Symbols are also often used with indicator lights. This is a core part of the project

We will collect examples of these on existing products as well as interview product designers about their choices and intentions in choosing among the available symbols. We will identify potential problems and advantages of different implementations.

Basic indicators

Nearly all devices have an indicator to show that they are on or off, with many also indicating low-power modes as well. A key issue is the best number of major power modes that the casual user should be exposed to, and the characteristics—internally and externally—of the major modes. Indicators are usually some color (including 'off'), and are often associated with terms or symbols.



We will collect many examples of indicator colors and the terms and symbols associated with them. We will also collect some specific examples of the power levels associated with internal power modes along with external characteristics to help identify patterns of these. We will seek to include several multi-function device examples in this review. For all, we will assess possible problems and solutions.

Changing power states [L]

Devices may change their power state (to on, low, or off) based on delay timers, weekly timers, a controlling device, user input, or action of a controlling device. Some may also respond to external stimuli such as electricity prices. For user input, simplicity and consistency of changing power states is desirable. This might be a switch/button, a switch analogue (e.g. laptop lid), keyboard input, mouse movement, voice use ("wake up!") or occupancy. Common actions will be turning on (from off), turning off (from sleep or on), putting to sleep (from on), or waking up (from sleep). In some cases, wakeup signals such as key presses need to be ignored as the effect may be unknown without necessary context from a display which is off. Some devices presently have "hot keys"—specific keypress combinations which cause a particular action, so a standard convention for such keys may be helpful.

The first task will be to catalogue the range of actions which cause state changes and particular behavior associated with them.

Transition indicators [L]

Any transition between two power states could potentially cause some type of external indication. Many devices make different noises in different power modes (e.g. when fans, disks, or motors change state), or do so on transitions (e.g. when these mechanical devices spin up or down). Some computers make intentional extra sounds when booting up, or waking up to confirm to the user that the process is underway. Such indicators can help when devices can't be seen (e.g. PCs under a desk), or take time to accomplish (e.g. a slow monitor). Some indicators are static, presenting a fixed representation of a power state. Others are dynamic, going through a particular process during state transitions. Some of these are designed for user benefit, such as 'count-down' timers that indicate when a device will be ready (these exist on some copier models).

Our data collection will catalogue the range of transition indicators we find or anticipate, as well as review specific examples that are particularly informative.

A minor aspect of this topic is 'quick state transitions'. Devices may enter short wake states in the midst of a long sleep period, or vice versa. States smaller than some minimum should probably be suppressed with respect to external indicators, as they may be difficult to discern and/or distracting. We will simply record examples as we come across them.

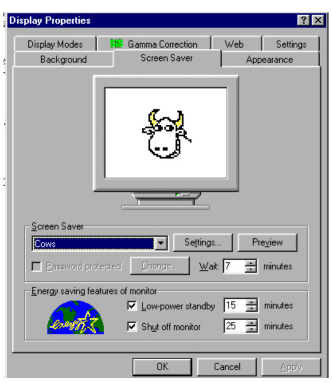
Underlying archetype of power management behavior, including basic terms [L]

It may be that a common analogue or archetype is desirable to help people learn and remember power management terms and behavior. An example of this is the idea of devices going to 'sleep'. This can bring in symbols (the moon and sun) and other terms ("waking up"). Variants can also be introduced (e.g. "snooze", "doze", "deep sleep", or "hibernate"). Another analogue could be 'active' vs. 'resting'.

This is one of the more complicated topics in the whole project. We will catalogue examples of archetypes as we come across them, and do limited review of literature that can inform the topic. We will seek related examples for how they may inform the topic. We will create a simple state diagram of states and transitions for the user states, and annotate it with terms and symbols as feasible. This is also an area that may be well served by interviews of interface designers.

This is the topic under which we will review and examine terms used in power management user interfaces, cataloging examples as we find them.

Controlled and controlling devices [L]



Whereas some devices manage their own power status, others (such as monitors) are dependent on a second device to determine when to change their power state. The number of such devices (controlled by others) is likely to rise.

The first task for this topic is to create a list of example pairs of such devices along with discussions of the implications that the control relationship has for user interfaces. After this is done, we will recommend to the PAC further data collection and analysis necessary for this topic. An example issue within this topic is the behavior of a controlled device when normal communication with the controlling one is lost (i.e. that it might automatically go to sleep after a defined time of no communication).

Remote indicators and controls [L]

As devices are increasingly networked, there is more ability of one device (usually a computer) to access the controls of another. This is distinct from (but not exclusive of) the control of one device by another[1]. For example, printers are increasingly managed remotely. The content of such user interfaces may be dependent on both the controlled and controlling device. On a monitor, the computer controls the content of the control panel. Printer screen

[1] For example, device A may have a user interface and controls for it to power manage device B; device A may have a user interface to query and change the controls for device B, but with the control function residing in device B.

icons on some current computers indicate if the printer is actively imaging. Similarly, screen icons could indicate power status, and possibly transitions between states.

We will first collect examples of remote indicators and controls—both existing and potential ones—along with issues that are raised. For example, there may be circumstances in which security concerns dictate that power status should be obscured. It may be desirable to make power management settings be readable under more circumstances than they are changeable (at present the two almost always go together).

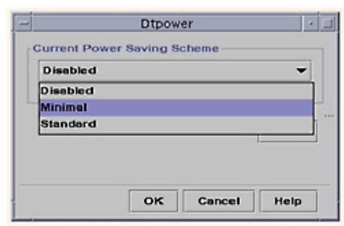
An increasingly common example of remote interface elements is on remote control devices similar to those most commonly used with televisions. We can expect more of these to be used, particularly in homes. These may have both button-like controls and indicators; controls for changing automatic power management are perhaps less likely but possible. For the most part we will simply report on those remote controls that we come across.

Composite devices and diversity of low-power modes [L]

A composite device is one in which different components may be in disparate power states. Many PCs are examples of this, with monitors, extra processors, disks, and communication cards all potentially in different power states from that of the processor. Imaging devices may similarly have components that can be independently active, particularly multi-function devices. How this composite value is reflected in a single indicator may be challenging.

Many devices have multiple low-power modes. Some, such as display dimming or processor clock slowing, may be leave the system more 'awake' than 'asleep' yet still save energy. In many cases it is desirable to not require users to be exposed to the diversity of all available modes, yet still allow the control for those who need or want it. Such two-tier controls are already used in some devices. For devices which use specifications with many internal states, it may be desirable for the protocols to have recommended mappings from the internal states to standard user interface states that are probably fewer in number.

Power management 'schemes' [L]



Several operating systems already provide for sets of power management settings to be saved together for ease of setup (several default schemes are provided) and changing. Schemes become particularly desirable as the number of controls elements rises, such as with weekly timers and multi-function devices. It may be desirable to provide guidance for names and implications of some default schemes, and specify that there be limitations on how the defaults can be modified.

We will record examples of scheme mechanisms as we come across them, including the particular schemes provided as defaults. Schemes may have considerably more use in the future than they do at present, so we will also speculate on their potential development and ask product developers about them to anticipate interface issues. Because of their complexity, schemes are an area particularly ripe for both user confusion and benefit from standardization.

Behavior based on wake event type [M]

As devices become more networked, an increasing number of wake events may not be relevant to the user, such as file access by a remote user or automated downloading of information or software. These may only require a portion of the machine to wake up and may have different sleep delay times may be appropriate. The potential number of combinations of such controls are large, so methods to group and simplify these will be needed to optimize energy savings.

Initially we will only record examples of this as we come across them supplemented by informed speculation.

Linked behavior [L]

Some current computers will provide an option to automatically save open files before shutting down the system, and having the ability to applications run on system startup or shutdown is quite common. Some consistent terminology may be appropriate, as may be the ability to do actions based on going to sleep or waking up.

We will record examples of such behavior as we find them as well as pitfalls and issues they raise.

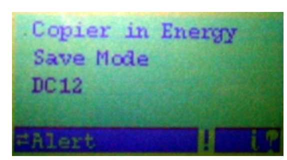
Interactions with non-power modes [S]

Power status is often not the only indication present on a device. For example, there may be indicators for error modes (e.g. paper jam), warnings (e.g. low battery, low toner, network connection lost), or that a message has been received. These other modes may interact with power management status (e.g. forcing or preventing sleep), and may utilize the same scarce indicators. For example, a single LED could change color with the power state, and flash for error or message indications.

For selected examples we will interview interface designers to identify issues and choices when harmonizing power and non-power modes. More generally, we will note indicator and device behavior when the modes collide or are closely related (in general we will not record error indicator behavior).

Priority 2 Topics

Disability [M]



The needs of people with disabilities should be considered. Of key concern are those users who are blind, have limited vision, are color-blind, or deaf. This might be accomplished with redundant or standard optional indications. Such standard options might be desirable for other purposes as well (e.g. audio indications when the device can't be seen directly). Many disabilities, such as manual dexterity, do not pose a challenge to this effort, as we don't expect to explore variables that affect mechanical aspects of devices.

We will collect examples of interface elements that have been adapted for the purpose of accommodating disabilities, and those for which an alternative seems most needed. This may include criteria by which to evaluate alternative elements. We will contact the Access Board to avoid any possible conflict between the requirements it promulgates and recommendations of this project.

Culture [S]

Any new symbols, words, or colors should be checked for problematic cultural associations that would argue against their use. This is an area in which the international standards community could be particularly helpful.

We will devote only a modest level of effort to this task, primarily just noting issues that seem of possible concern and resources that may be useful in assessing these. We can ask manufacturers of interface elements that have been controversial. This topic is most appropriate during the phase of the project when candidate interface elements are identified.

Temporary changes [S]

Sometimes a user may want a temporary change in the power management scheme until some event has passed. Disabling monitor power management for presentations and while diagnosing a system problem are common applications of this. Having an explicit facility for temporary disabling would reduce the degree to which these become permanent.

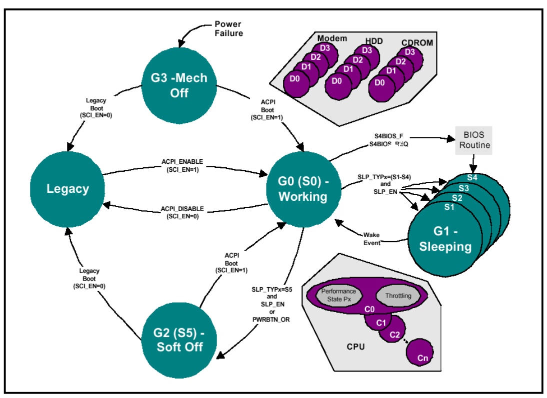
We will record any examples of this that we come across as well as suggest how it might be implemented, such as the temporary change being valid for an hour, a day, or until the next system restart.

System status after power failure [S]

An increasing portion of computers offer the ability to control the systems state after a power failure, either always staying off, always rebooting, or whichever state the system was in prior to the power failure. If a large number of devices turn themselves on specifically after a power failure, there may be implications for grid stability.

Initially, we will simply record instances of this ability as we come across it along with terms and symbols used for the control

Terminology [S]



In the course of the project we may collect information useful for attempts to achieve convergence on power mode terminology <u>not</u> generally intended for final user use, such as in power management protocols, test procedures, and labeling program specifications.

This topic will be addressed mostly through passively recording terminology sets as we encounter them, and making this available to others. Results from the analysis of user terms may influence the ultimate choice of internal ones.

Miscellaneous [S]

Many devices are confronted with confounding factors or anomalous situations that can challenge power management controls and indicators. Some of these are: Multiprocessor systems (which may be in different power states); operating system upgrades (which may ‘lose’ configuration settings); uncertainty about what wakes the system (particular when this depends on how a device is connected to a PC); software setting of hardware button behavior; and distributed processing (e.g. SETI@home).

This topic area will be used to keep track of data points which seem significant but don’t naturally fall into any of the other areas.

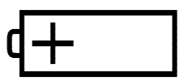
<u>Priority 3 Topics</u>

Language [S]

Standard UI terms will need to be translated to other languages, or become so widely recognized as to not need translation (as an increasing portion of users do not use English at all). Doing this translation is beyond the scope of this project.

We will pursue this topic at a low level of effort, primarily through passive collecting of non-English terms, and noting any appropriate process or organization well suited to accomplishing the translation. Manufacturers are faced with this issue in adapting products to different languages, so it may be possible to tap their resources to identify some candidate translations.

Batteries [S]



Battery status presents many potential controls and indicators. Indicators might include battery presence or absence, total capacity (time), remaining capacity (time), battery health, and charging status. Controls include charging method, and low-battery actions. We are assuming that there are no major problems with battery interface elements with significant energy consequences.

We will collect limited examples of battery interfaces, and ask designers about them to glean 'lessons learned' that may be helpful to this project.

Role of the term "ENERGY STAR" [S]

It is common for users and manufacturers to use "power management" and "ENERGY STAR" synonymously, even though some compliant devices lack power management, and some with power management do not qualify as ENERGY STAR. While there is initial utility in such ambiguity, it is probably better for the long run to keep the ideas separate.

Our activities in this area will be to record notable examples as we find them (mainly when the two concepts are conflated) and provide a basic discussion of the issue for manufacturers.

Self-monitoring [S]

Some systems and add-on software provide for tracking power management states over an extended period of time. Some conventions on recording and reporting of this may aid comprehension of such data.

Primarily we will record examples of this as we find them (most commonly in third-party software for computers).